THE WEATHER AND CIRCULATION OF AUGUST 1955 [1]

Including the Climatological Background for Hurricanes Connie and Diane

JEROME NAMIAS AND CARLOS R. DUNN
Extended Forecast Section, U. S. Weather Bureau, Washington, D. C.

ABSTRACT

The general circulation during August 1955 was characterized by an abnormally contracted circumpolar westerly whirl and an associated northward displacement of the belt of subtropical anticyclones and subtropical easterlies. While this zonal circulation was similar in many respects to that of the preceding July and led to a pattern of temperature anomaly over the United States similar to July's, the rainfall differed tremendously, particularly over the Northeast where flood-producing rains associated with hurricanes Connie and Diane replaced a regime of drought. The differences between July and August are accounted for by westward displacements of the centers of action coupled with markedly similar anomalous zonal circulations (i. e., displaced poleward). The early onset of the hurricane season is attributed to the premature northward displacement of the subtropical belt of anticyclones. The unprecedented precipitation associated with hurricanes Connie and Diane is believed to be partially related to injection of abnormally moist tropical air from an appreciably warmer than normal sea surface.

1. CLIMATIC BACKGROUND FOR HURRICANES CONNIE AND DIANE

Climatic fluctuations of short and long duration in temperature, precipitation, and other meteorological elements are accepted by meteorologists as characteristic phenomena of the atmosphere. Since the genesis and paths assumed by tropical storms are extremely sensitive to a number of factors it is not surprising that there are great fluctuations in frequency, character, and paths of hurricanes. The senior author of this paper has tried to elucidate this point in connection with month-to-month and year-to-year fluctuations in the vulnerability of the Atlantic Seaboard to tropical storms [1].

In this connection the statements expressed by Bergeron [2] are especially noteworthy:

> Another problem, of much more far-reaching consequences, presents itself. What kind of secular changes may have existed in the frequency and intensity of the hurricane vortices on our Earth? And what changes may be expected in future? We know nothing about these things, but I hope that this paper may have shown that even quite a small change in the different factors controlling the life history of a hurricane may produce, or may have produced, great changes in the paths of hurricanes and in their frequency and intensity. A minor alteration in the surface temperature of the sun, in the general composition of the earth's atmosphere, or in the rotation of the earth, might be able to change considerably the energy balance and the balance of forces within such a delicate mechanism as the tropical hurricane. During certain geological epochs, hurricanes may have been just as frequent as the cyclones of our latitudes, or they may have occurred all over the oceans and within all coastal regions, and they may have been even more violent than nowadays. During other periods they may have been lacking altogether. In studying paleo-climatic and paleo-biological phenomena, especially along the coasts of previous geological epochs, it may be wise to consider such possibilities.

The 1955 crop of hurricanes contained two early season storms, Connie and Diane, which will furnish ample material for several meteorological investigations. It is hoped that these investigations, as well as researches in connection with hurricanes in general, will not ignore the long-period aspects of the general circulation which in effect set the stage for smaller-scale phenomena that subsequently develop.

In the case of hurricanes Connie and Diane two climatological factors bearing on their formation and course appear highly pertinent:

1. The planetary zonal wind systems during the two months preceding their formation were appreciably farther north than normal, and
2. The regions in which the zonal wind systems were displaced farthest northward were over eastern North America, the eastern Atlantic and Europe, and the west central Pacific.

These displacements in August are illuminated by the zonal wind speed diagrams shown in figures 1 and 2A. The abnormal northward displacement of zonal wind systems was observed starting as early as late June. For example, 700-mb. zonal wind speed profiles for the period from mid-June to mid-July (not shown) showed a peak at 52° N.—a full 10° north of normal. The northward displacement during July was associated with record-breaking and sustained heat and dryness over northeast portions of the country, but relatively cool, wet conditions over the Southeast—a topic treated at length in the preceding article of this series [3].

[1] See Charts I–XV following p. 184 for analyzed climatological data for the month.

358374—55——2

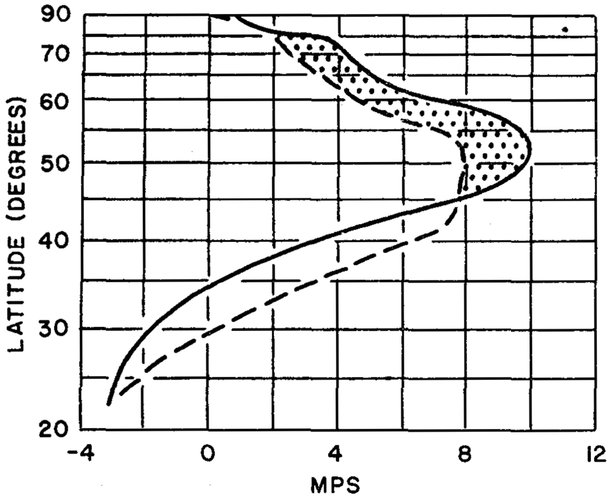


FIGURE 1.—Mean 700-mb. zonal wind speed profile in the Western Hemisphere (0° westward to 180°) for August 1955. An abnormally contracted circumpolar vortex was associated with above normal westerlies north of 45° N. (stippled area) and subnormal westerlies to the south. Note the strong easterlies in the subtropics.

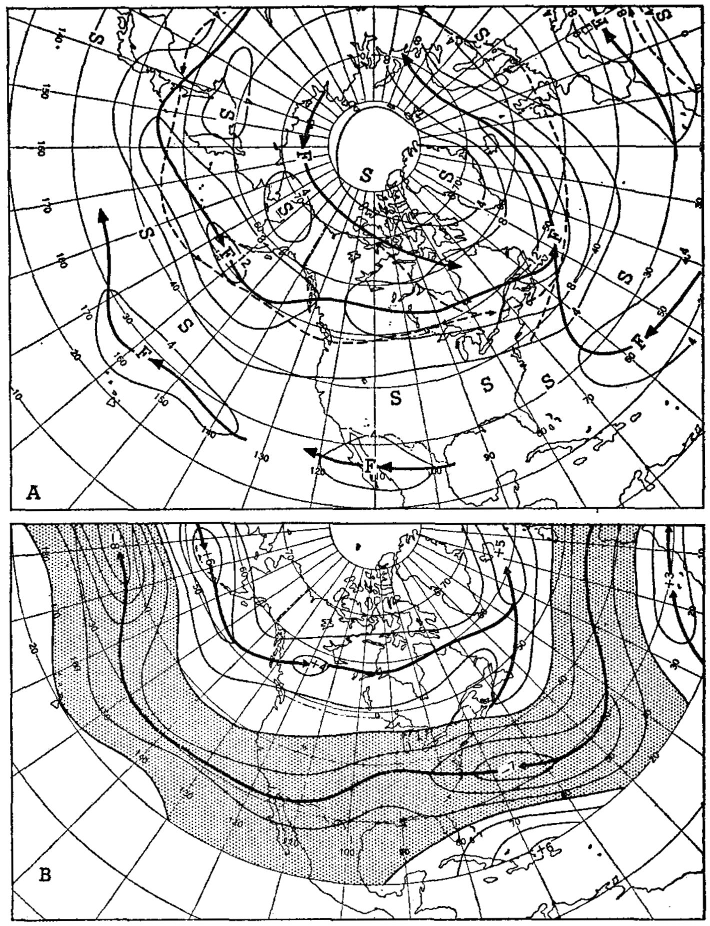


FIGURE 2.—(A) Mean 700-mb. isotachs and (B) departure from normal of zonal wind speed component (both in meters per second) for August 1955. Solid arrows in (A) indicate positions of mean 700-mb. jet axes, and broken arrows their normal August positions. The westerly jet was north of its normal location at all longitudes in the Western Hemisphere. Solid arrows in (B) delineate axes of maximum easterly and westerly anomalous flow with westerlies considered positive.

Since the subtropical Atlantic anticyclone was well north of normal and associated with a compensating deficit of mass in lower latitudes, it is perhaps not surprising that the Atlantic hurricane season got under way early with detection of hurricane Connie on August 4. In other words, the northward seasonal march of the planetary zonal circulation was advanced ahead of normal, so that events (i. e., hurricanes) which most frequently get under way in late August could get an early start. In this respect a quotation from C. L. Ray [4] seems pertinent:

> Spring and summer pressure deviations in the North Atlantic, as indicated by the pressure at San Juan, have an inverse relation to tropical storm frequencies of the summer and autumn months. This is best indicated where pressure continues above normal from May through July, but is also related definitely to the July departure considered singly, and also as early as April-May.

This statement of Ray's reflects the summer persistence of anomalous features of the general circulation over southern portions of the North Atlantic. Indeed persistence of 700-mb. height anomalies over this hurricane breeding area is especially pronounced from July through September (see fig. 3 A and B from [5]). Whatever the ultimate cause of this persistence, it seems clear that the same factors which led to the great frequency of easterly waves which affected southeastern United States in July [3] also favored the early incidence of hurricanes in August.

While hurricane Connie was first reported on August 4 at about 16.6° N. and 48.0° W., there is some indication that it developed off North Africa some time earlier. At any rate planetary wave forms over the North Atlantic evolved in a manner which the authors have come to associate with tropical storm formation. Thus in late July the ridge of the Azores upper level anticyclone thrust strongly northeastward into Europe, thereby introducing a northeasterly flow which, through vorticity flux, led to an anomalously sharp and deep trough extending along the Spanish and African coasts (see fig. 4 A and B). It was probably at the base of this trough that Connie developed—its formation encouraged by the injection of cyclonic vorticity from the north and by associated vertical destabilization processes as discussed in an earlier report [6]. If this hypothesis is correct, the frequency of tropical storms of the Cape Verde type may well depend upon the degree of development or suppression of the protruding Azores ridge to the north.

While the physical explanation of persistence of circulation features from July through August lies outside the scope of this report, there may have been some resultant effects on water temperatures off the Atlantic Seaboard which could have had a profound bearing on the hurricanes Connie and Diane—especially regarding their copious rainfall.

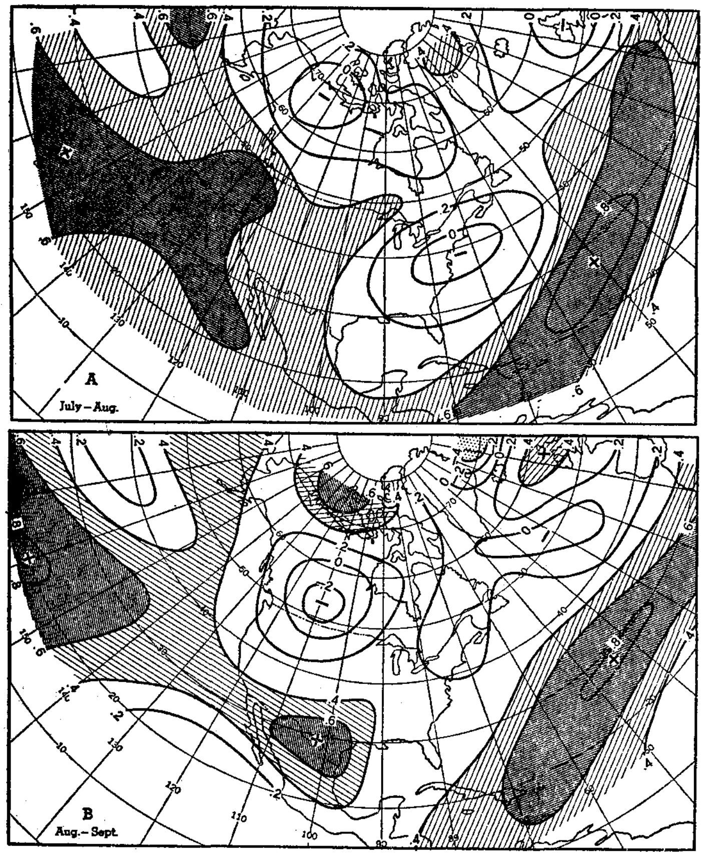


FIGURE 3.—Isopleths of one-month lag correlation between mean monthly heights of the 700-mb. surface for period 1932–1951 (from [5]). Persistence over southern portions of the North Atlantic is especially pronounced from July to September.

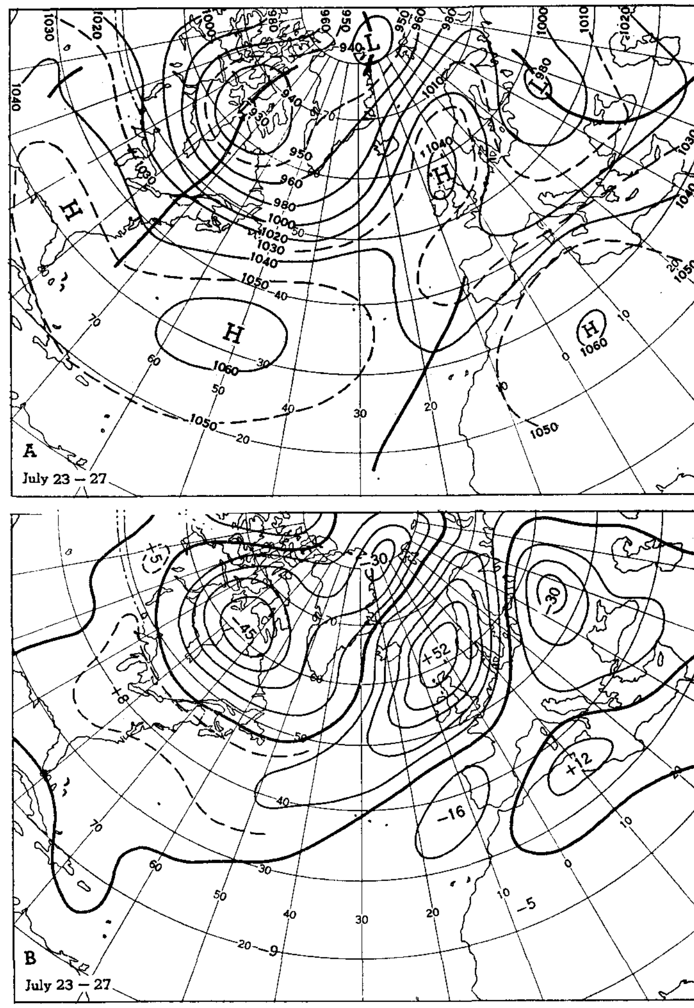


FIGURE 4.—(A) Mean 700-mb. contours and (B) mean, 700-mb. height departures from normal (both in tens of feet) for July 23–27, 1955. Sharp trough west of the Spanish and African coasts resulting from projecting ridge to its north was probable spawning ground for hurricane Connie.

The senior author of this report spent part of the past summer at Woods Hole on Cape Cod, Massachusetts. On this seacoast peninsula, afternoon sea breezes attended by comfortable temperatures and humidities are the rule. However, in the month preceding hurricanes Connie and Diane the sea breezes were oppressive to a degree rarely felt. Although no complete observations are available from this point the temperature and humidity observations from Boston and Hartford (table 1) indicate the abnormal warmth and moisture.

It seems probable that such high temperatures and particularly high moisture contents may have been due in part to abnormally warm waters off the northeast coast.

TABLE 1.—*July and August 1955 surface temperature and moisture content at Boston and Hartford*

	1955	Mean surface temperature °F. (to nearest degree)		Mixing ratio (g/kg)	
		Observed	Normal	Mean	Departure from normal
Boston, Mass.	July	77	72	13.4	+4.2
	August	75	71	13.2	+4.0
Hartford, Conn.	July	77	74	12.8	+3.7
	August	74	71	12.8	+3.7

In order to test this hypothesis all ship observations taken from mid-July to mid-August appearing on the eight synoptic charts per day in the area off the northeast coast were gathered and tabulated in the 2½-degree squares delineated in figure 5. The temperatures were then averaged for each square and the resultant values for the period were compared with the long-period (1912–31) averages given by Slocum [7]. The departures from this long-period average (or normal) are given in figure 5 along with the number of observations in each square. There seems to be little question that surface water temperatures off the northeast coast were above normal and especially so in areas close to the coast. While the complete explanation of this anomaly is a problem primarily for oceanographers, it appears that atmospheric conditions of July and early August favored abnormal heating of surface waters in this area because:

1. The air masses over the entire Northeast were

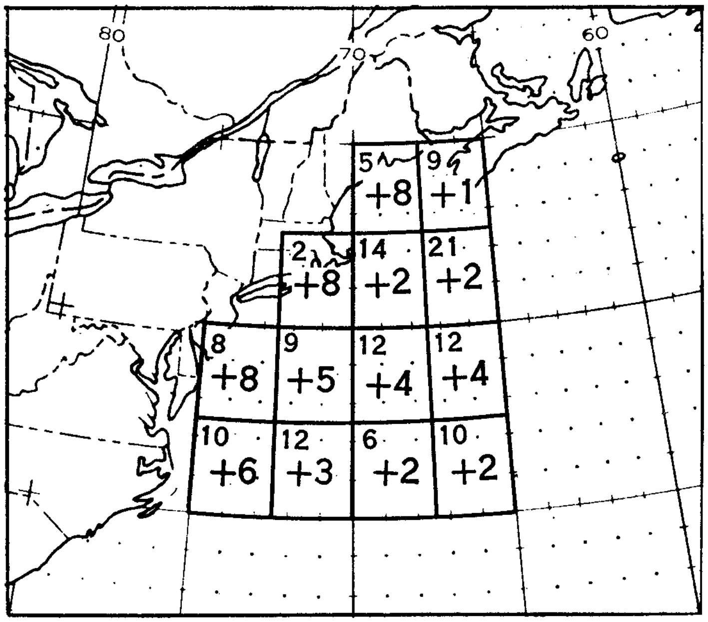


FIGURE 5.—Sea surface temperature departure from normal (° F.) by 2½-degree squares for July 16–August 15, 1955. Smaller figures in upper left hand corner give number of observations per square. Above normal temperatures especially near the coast are noteworthy.

abnormally hot. (See Chart I-B and also Chart I-B of July issue.)

2. Storminess (Chart X) was less than normal as indicated by the positive 700-mb. height anomalies (fig. 6), thereby inhibiting deep stirring of the surface layers.
3. The anomalous components of flow at sea level (Chart XI) suggest more than normal advective drift of warm water shoreward and weaker than normal prevailing southwesterly winds at the surface.
4. The mean pressure patterns (and absence of storms) suggest that more sunshine than normal affected the area, thus contributing to warming. Solar radiation measurements at Blue Hill Observatory, Mass., during July for example, showed an excess above normal of 13 percent in total radiation falling on a horizontal surface.

From hygrometric tables it appears that increases in mixing ratio of 4.0 g/kg as observed in July and August in southern New England would be of the general magnitude anticipated if the surface waters along the coast averaged from 5° to 10° above normal, as is indicated by figure 5.

An inspection of the synoptic charts for several days preceding hurricanes Connie and Diane indicates that air trajectories arriving over the northeast portion of the country emanated from a general southeasterly direction, thus moving across the Gulf Stream and coastal waters. Along the trajectories it appears that observed water temperatures equalled or exceeded dew point temperatures, thus making possible continual addition of moisture to the air from the sea, or at least helping to maintain the high moisture content characteristic of tropical air at its source.

The suggestion is that the torrential rains accompanying hurricanes Connie and Diane, particularly Diane which moved just south of New England, were caused not only by the usual factors associated with hurricanes, but also by the abundance of moisture supplied by an appreciably warmer than normal ocean source. Of course, this would not explain the complex detail of the isohyetal patterns of both storms. Expressed in other words, it seems that the oceanic source region for tropical air was in July and August of 1955 effectively extended northward along the Atlantic Seaboard. At least, these data are of sufficient interest to suggest that studies of ocean temperature anomalies should not be ignored in the search for the many rain-producing elements associated with tropical cyclones.

2. FORM OF THE GENERAL CIRCULATION

PRESSURE DISTRIBUTION

The pressure distribution in mid-troposphere during the month of August was very persistent and is well represented by the 700-mb. monthly mean (fig. 6). Planetary waves in the westerlies possessed little amplitude, except in Europe and western portions of the Soviet Union. The pronounced zonal nature of the mid-tropospheric flow is illustrated in figure 6 by the 700-mb. height departures from normal, where it is shown that a narrow filament of positive departures roughly along 45° N. latitude extended continuously through the troughs and ridges from China eastward to Europe. In polar regions vigorous cyclonic activity prevailed resulting in extensive below normal values of pressure at sea level (Chart XI) and height at 700 mb. (fig. 6). The 5-day 700-mb. departures from normal for periods one week apart during August (fig. 7A–D) illustrate the persistent nature of cyclonic activity in the Arctic.

Two other persistent anomalies which were apparently cornerstones of the monthly mean circulation were those over northern Europe and the west central Pacific (fig. 6). The former became established early in summer and maintained throughout the season [3 and 8]. During the period August 3–7 (fig. 7A) 5-day mean 700-mb. heights averaged above normal west of the British Isles, but by the following week (fig. 7B) this anomaly had progressed to Scandinavia where it remained throughout August. This prevalence of upper level anticyclones gave Scandinavia one of its finest tourist seasons in terms of sunny, rainless weather.

The positive monthly mean anomaly (310 feet) in the west central Pacific occupied an area normally characterized by a trough [9]. The sequence of 5-day mean height departures from normal (fig. 7) shows that a positive anomaly center in the central Pacific retrograded early in the month to a fairly settled position. The resulting

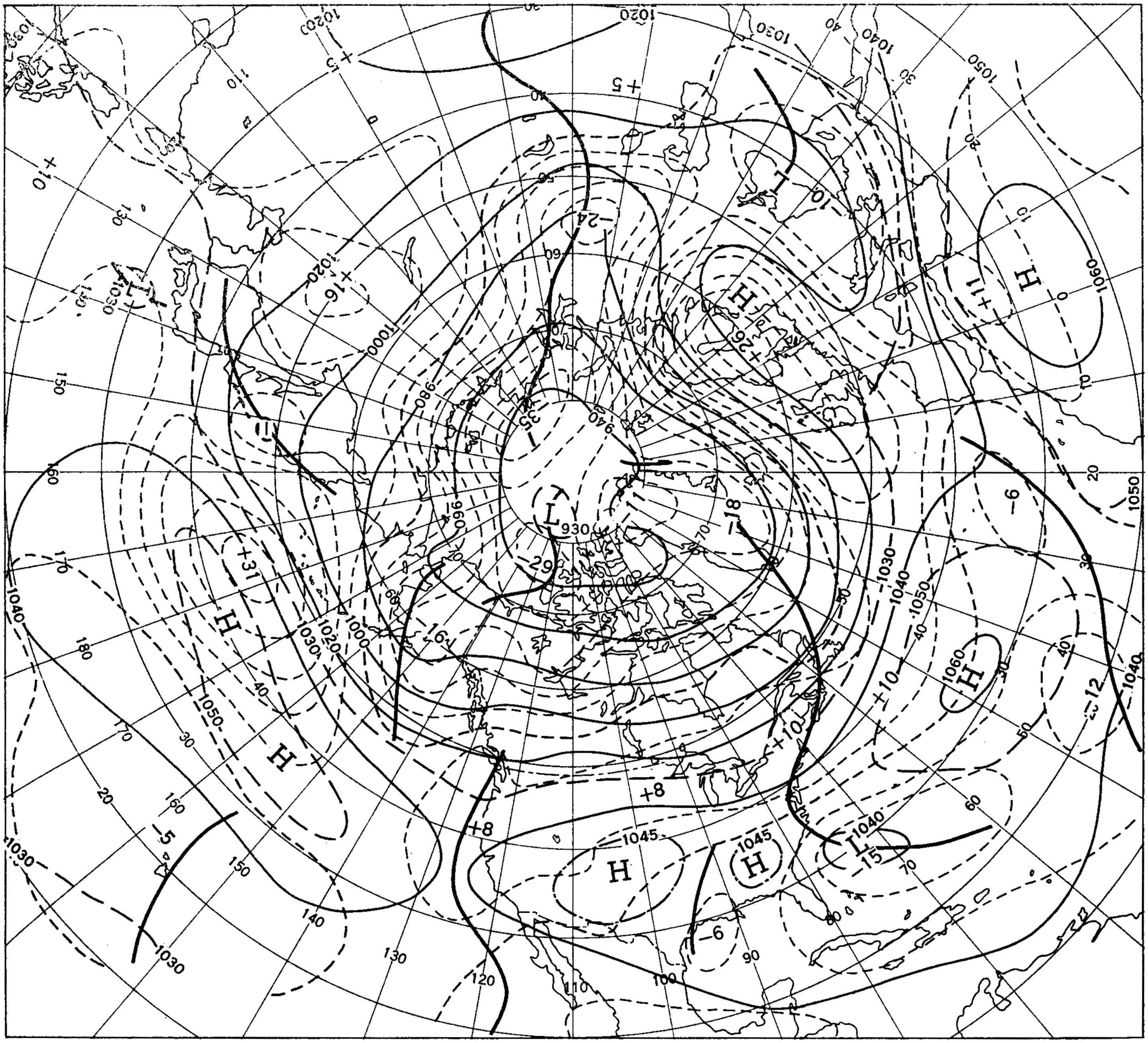


Figure 6.—Mean 700-mb. contours and height departure from normal (both in tens of feet) for August 1955. Note continuous zonal band of positive anomalies in middle latitude associated with contracted circumpolar vortex. Subnormal heights in tropical and western Atlantic as in July [3] appear to represent a long period "weakness" favoring formation of early season hurricanes.

westward displacement of the Pacific ridge encouraged storminess in the Gulf of Alaska, which in turn helped perpetuate a fast, zonal flow across North America.

Northward displacement of the westerlies, subtropical ridge, and intertropical convergence zone encouraged tropical disturbances to spawn frequently and early in August as described previously. Monthly mean sea level pressures (Chart XI) and 700-mb. heights (fig. 6) averaged below normal across the tropical Atlantic and southeastern United States with a maximum deficiency over the Sargasso Sea where at 700 mb. (fig. 6) a 10,400-ft. closed upper level cyclone was observed—a unique case in the historical record of 700-mb. mean maps dating from 1933. The most similar 700-mb. pattern for this immediate area occurred in August 1933 when a negative anomaly of 110 feet was observed east of Florida and the westerlies along the Atlantic Seaboard were subnormal. This case is mentioned because 1933 was a year unusually rich in tropical disturbances and included an intense hurricane which entered the mainland just north of Cape Hatteras.

While the mean negative anomalies at sea level and

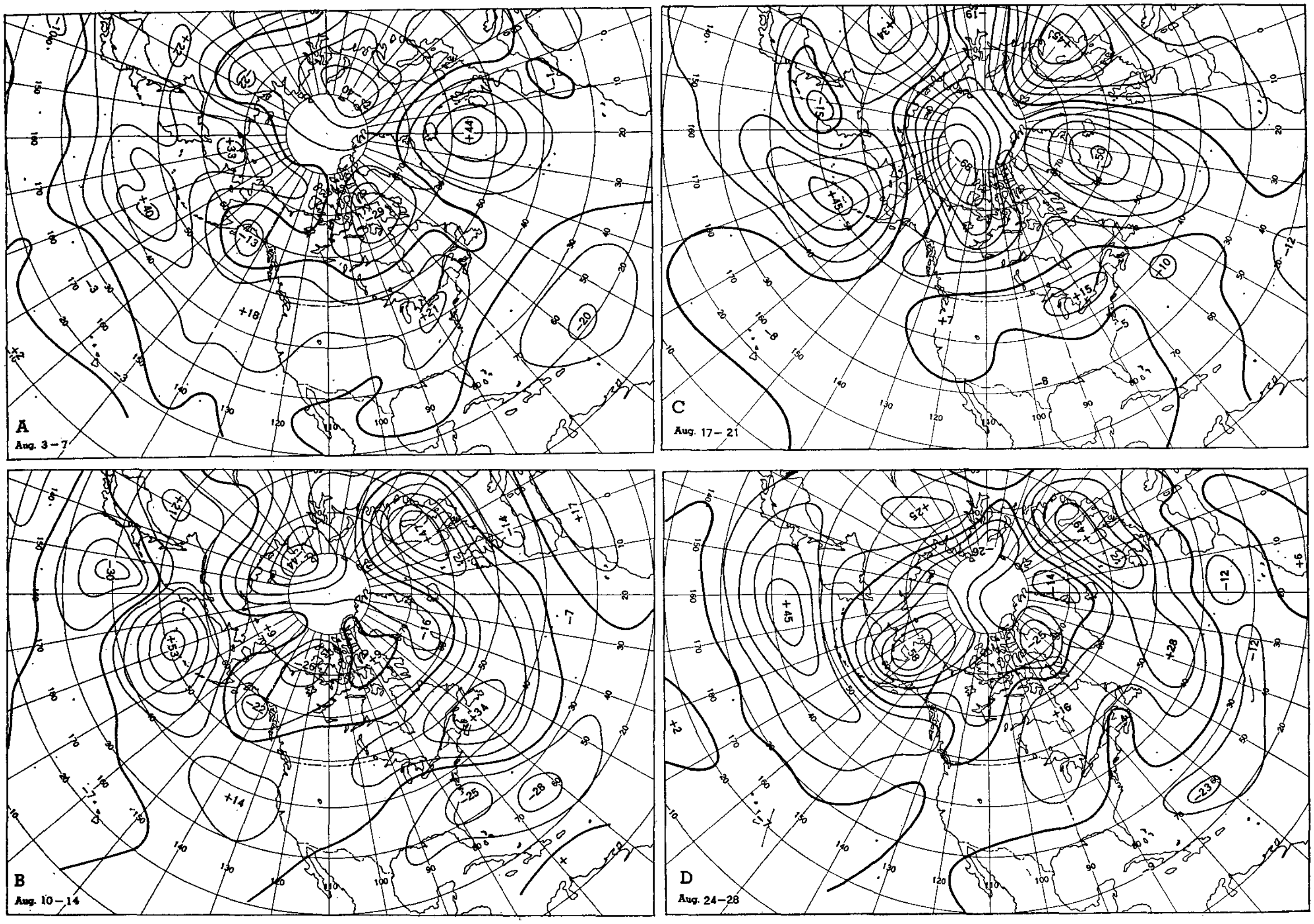


FIGURE 7.—Five-day mean 700-mb. height departures from normal (in tens of feet) for selected periods in August 1955 one week apart. Below normal heights persisted in the Arctic. Tenacious positive anomalies in the central Pacific and northern Europe were cornerstones of the general circulation.

aloft were naturally associated to some extent with the hurricanes, they were in fact manifestations of a longer-period pattern since they were more or less continuations of abnormalities established in June 1955 [8] and maintained in July [3].

ASSOCIATED WIND PATTERNS

The contracted polar vortex was associated with zonal wind speeds at 700 mb. about 5 m. p. s. greater than normal north of 45° N. latitude but below normal south of 45° N. (fig. 1). The maximum wind belt in August was approximately 5° of latitude north of normal (fig. 2A). The continuous bands of excess polar westerlies and subtropical easterlies at the expense of temperate latitude westerlies (fig. 2B) resulted in a rather uniform northward shift of the waves in the westerlies. The anomalous easterly flow in middle and low latitudes was responsible for the drift of August hurricanes onto the United States mainland, northwest of the more normal oceanic trajectory.

At 200 mb. the wind field (fig. 8) was similar to that at 700 mb. inasmuch as the jet axis was unseasonably far north. However, additional wind maxima associated with a confluent pattern in the eastern Pacific and a difluent configuration in the Atlantic were observed. Average wind speeds in excess of 30 m. p. s. maintained over parts of North America. On normal maps for the 13-km. level (about 200 mb.) the westerlies during August increase uniformly from about 5 m. p. s. in northern Florida to 20 m. p. s. in central New England [10]. In August 1955 easterlies existed at 200-mb. levels from the latitude of Florida to Cape Hatteras, and the westerlies north of Hatteras were about 5 m. p. s. below normal. Therefore, the hurricanes of this August had a high probability of encountering prevailing deep easterly currents extending from the surface to the tropopause.

CYCLONE TRACKS

Most of the extratropical cyclones of August were observed north of the axis of maximum mid-tropospheric westerlies, although no strongly preferred storm tracks were apparent (Chart X). In Canada the paths were rather uniformly distributed from the United States border to the Arctic. Several storms passed near the Aleutians and moved into the Gulf of Alaska or the Bering Strait. East of the Rocky Mountains the cyclone tracks were more numerous but only three weak disturbances formed far enough south to affect the United States, where most of the storms entering the country were of tropical origin. Here again the freedom from extra-tropical storms and increased vulnerability to tropical storms is to be associated with the northward displacement of zonal wind belts.

3. PREVAILING WEATHER OVER THE UNITED STATES

As indicated previously showers and tropical storms produced most of August's rainfall (Charts II and III). With a mean 700-mb. anticyclone located over western Texas and New Mexico moist unstable air masses were advected into the Far Southwest producing heavy rainfall and floods in Arizona and lesser amounts of precipitation north-northeastward to the Canadian Border in a manner described by Reed [11]. The rather anomalous westward extension of "Arizona rains" into southern California, often called "Sonora rains," was associated with easterly winds aloft, as noted by Blake [12]. Tropical storm Brenda which entered Louisiana August 1 (for earlier history see [3]) combined with other easterly perturbations to produce heavy rains totaling up to 10 inches along most of the Gulf Coast.

Abundant rainfall fell over large areas of the Northeast and in many States (e. g., Connecticut, Massachusetts, New Jersey, New York, Pennsylvania, and Rhode Island) torrential downpours led to disastrous floods. In the Great Lakes area, New York, and New England cold fronts encountering tropical air masses helped induce strong convective activity. For example, flash floods were reported August 17 in northern Vermont and August 13 in the Upper Valley of New Hampshire. However, the heaviest amounts of precipitation occurred when this humid air entered the moisture-wringing circulations of hurricanes Connie and Diane. Attended by hurricane-force winds, Connie came inland in North Carolina on August 12 (Chart X) and in so doing released as much as 5 to 6 inches of rain along and east of its meandering path. Heavy rains in New York and New England fell on August 12 and 13 due to Connie's influence, although the storm center was still several hundred miles to the south. These rains were augmented by lifting of moist air over a cold front which passed through New England. A somewhat similar situation occurred in 1954 in Ontario when hurricane Hazel produced flood conditions [13]. Hurricane Diane with 70- to 100-m. p. h. winds followed in the wake of Connie and struck the coast near Wilmington, N. C. (Chart X). A detailed description of the hurricane trajectories is presented by Chapman and Sloan elsewhere in this issue. Coarse figures of rainfall amounts

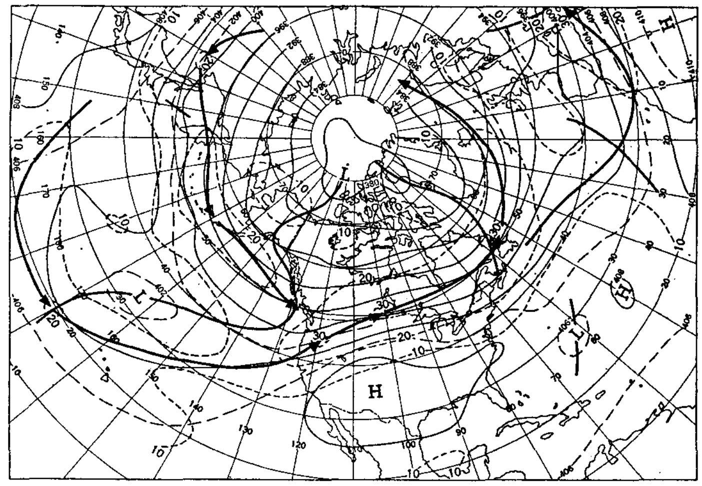


FIGURE 8.—Mean 200-mb. contours (in hundreds of feet) and isotachs (dashed, in meters per second) for August 1955. Solid arrows indicate the axes of mean jet streams, which were north of normal in eastern North America and the Atlantic.

associated with Diane varied from 6 inches in North Carolina, 11 in Virginia, 10 in Pennsylvania, to more than 20 in southern New England.

In the Far West dry weather prevailed since the west coast trough was weak and local westerlies were subnormal thereby minimizing orographic effects. The Central Plains were also dry; less than half the normal precipitation fell in a north-south band. Associated with this deficiency was the absence of cyclones and deep moist air masses, both resulting from a northward displaced and zonally oriented subtropical ridge of high pressures aloft. Rainfall was also deficient underneath an upper level anticyclone in the Southeast where northerly components of flow prevailed (fig. 6).

The intense heat wave of July across the northern half of the country east of the Rocky Mountains, continued throughout August (Chart I). Many stations reported temperatures comparable to those of August 1947, another hot month, and at some stations new records were made. For example, Cleveland, Ohio, experienced the second hottest month on record which followed the hottest month ever recorded. The mean monthly temperature at East Lansing, Mich., of 75.4° F. exceeded the old record made in 1947. Sioux City, Iowa, reported torrid temperatures, bright sunshine, hot winds, and low humidities which, combined with light precipitation, resulted in heavy crop damage. These meteorological conditions were characteristic of much of the Plains States where a crop moisture deficit [14] of 4 inches was reported throughout August.

In the Rocky Mountains and along the Gulf Coast below normal temperatures were less extensive than in July, but they still prevailed in parts of the rainy Southwest and the West Coast. August was the seventh consecutive month of subnormal temperatures in the Pacific

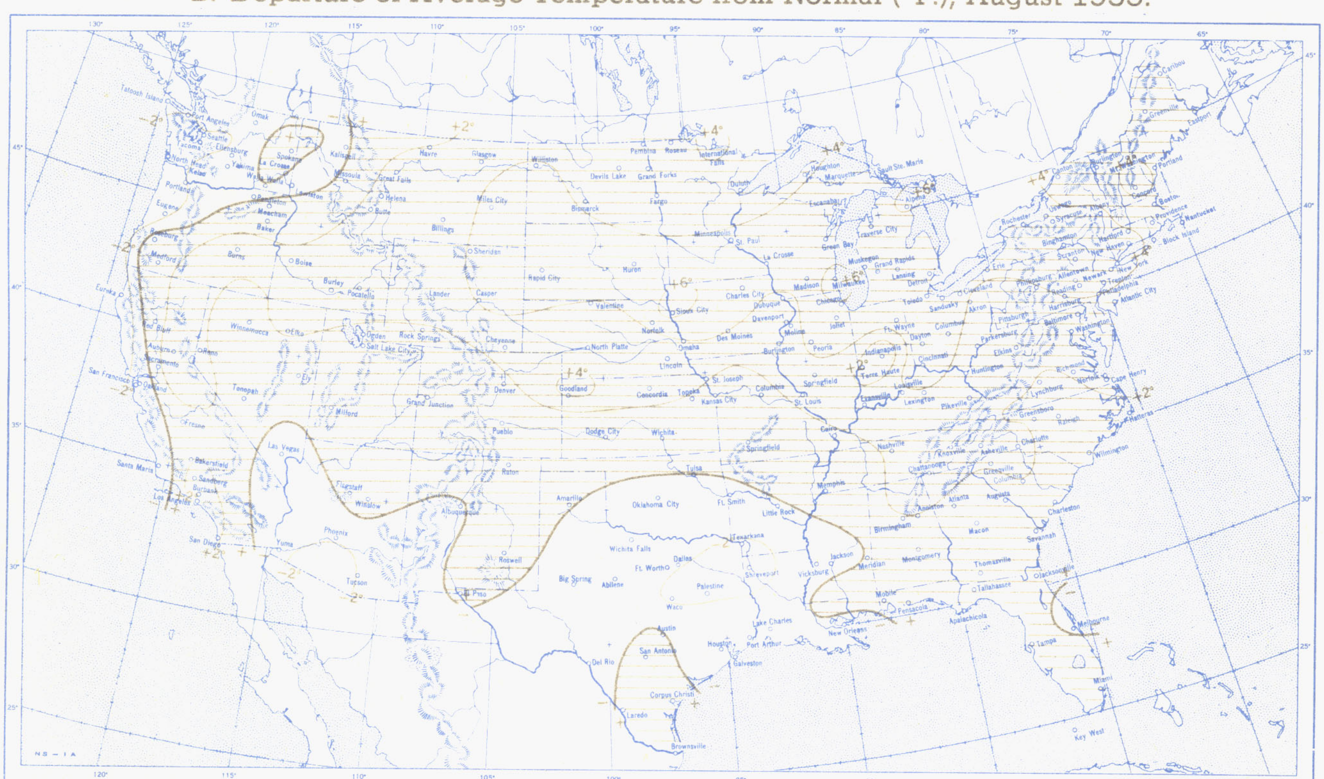
Northwest. It is somewhat unusual that cool summer temperatures here were associated with sunny and dry weather. In fact, August was the sunniest month ever observed in Spokane, Wash., and Tatoosh Island, Wash., received the lowest amount of precipitation since 1916.

REFERENCES

1. J. Namias, "Secular Fluctuations in Vulnerability to Tropical Cyclones In and Off New England," *Monthly Weather Review*, vol. 81, No. 8, August 1955, pp. 155–162.
2. T. Bergeron, "Reviews of Modern Meteorology—12. The Problem of Tropical Hurricanes," *Quarterly Journal of the Royal Meteorological Society*, vol. 80, No. 344, April 1954, pp. 131–164.
3. J. F. Andrews, "The Weather and Circulation of July 1955—A Prolonged Heat Wave Effected by a Sharp Reversal in Circulation," *Monthly Weather Review*, vol. 83, No. 7, July 1955, pp. 147–153.
4. C. L. Ray, "Relation of Tropical Cyclone Frequency to Summer Pressures and Ocean Surface-Water Temperatures," *Monthly Weather Review*, vol. 63, No. 1, January 1935, pp. 10–12.
5. J. Namias, "Further Aspects of Month-to-Month Persistence in the Mid-Troposphere," *Bulletin of the American Meteorological Society*, vol. 35, No. 3, March 1954, pp. 112–117.
6. J. Namias, "Long Range Factors Affecting the Genesis and Paths of Tropical Cyclones," *Proceedings of the UNESCO Symposium on Typhoons, 9–12 November 1954*, Tokyo, 1955, pp. 213–219.
7. G. Slocum, "The Normal Temperature Distribution of the Surface Water of the Western North Atlantic Ocean," *Monthly Weather Review*, vol. 66, No. 2, February 1938, pp. 39–43.
8. H. F. Hawkins, "The Weather and Circulation of June 1955—Illustrating a Circumpolar Blocking Wave," *Monthly Weather Review*, vol. 83, No. 6, June 1955, pp. 125–131.
9. U. S. Weather Bureau, "Normal Weather Charts for the Northern Hemisphere," U. S. Weather Bureau, *Technical Paper*, No. 21, Washington, D. C., 1952, 74 pp.
10. U. S. Weather Bureau, Northern Hemisphere Isograms of Normal Wind Speed and Stream Lines, Upper Level. (Unpublished, based on *Normal Weather Maps, Northern Hemisphere, Upper Levels*, 1944.)
11. T. R. Reed, "The North American High-Level Anticyclone," *Monthly Weather Review*, vol. 61, No. 11, November 1933, pp. 321–325.
12. D. Blake, "Sonora Storms," *Monthly Weather Review*, vol. 51, No. 11, November 1923, pp. 585–588.
13. J. L. Knox, "The Storm 'Hazel'," *Bulletin of the American Meteorological Society*, vol. 36, No. 6, June 1955, pp. 239–246.
14. D. E. McCloud and L. D. Bark, "A Trial Crop Moisture Computation," *Weekly Weather and Crop Bulletin, National Summary*, vol. XLII, No. 32, August 8, 1955, pp. 6–8.

Chart I. A. Average Temperature (°F.) at Surface, August 1955.

B. Departure of Average Temperature from Normal (°F.), August 1955.



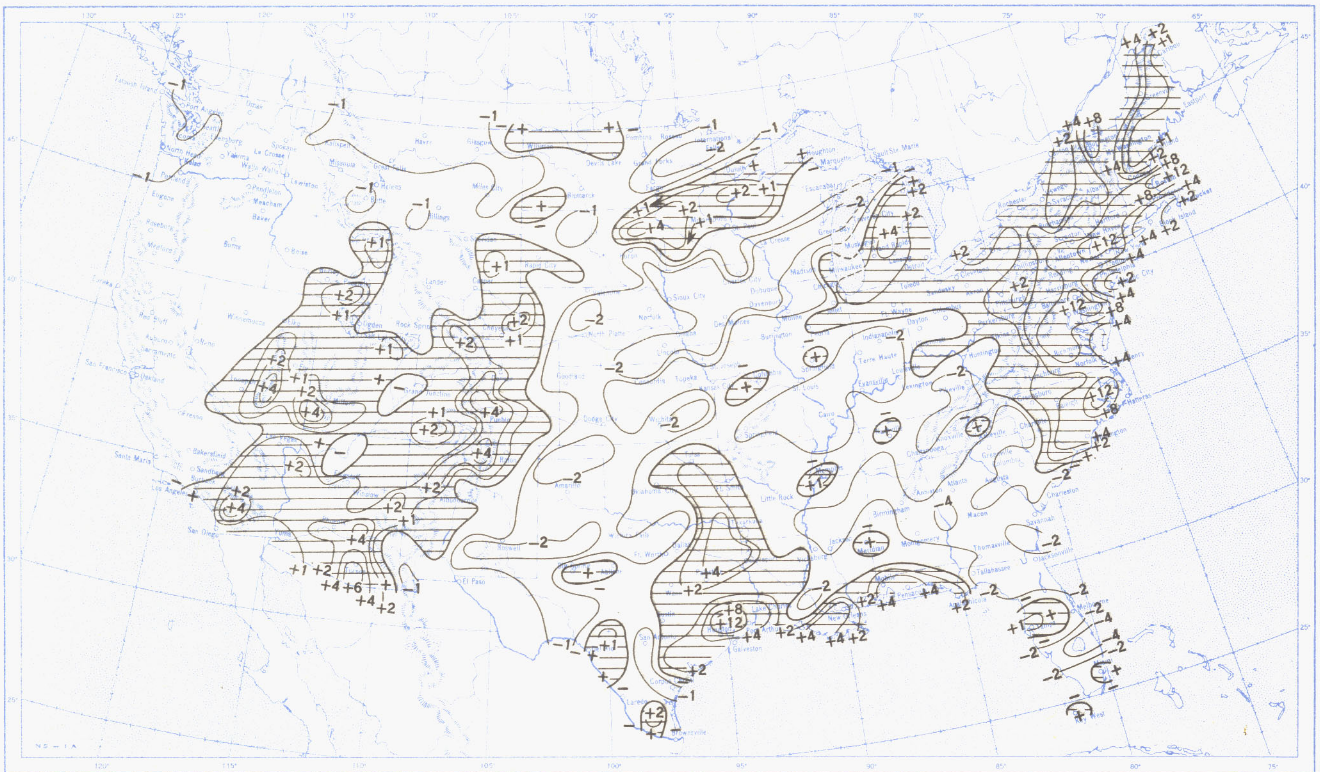
A. Based on reports from 800 Weather Bureau and cooperative stations. The monthly average is half the sum of the monthly average maximum and monthly average minimum, which are the average of the daily maxima and daily minima, respectively.

B. Normal average monthly temperatures are computed for Weather Bureau stations having at least 10 years of record.

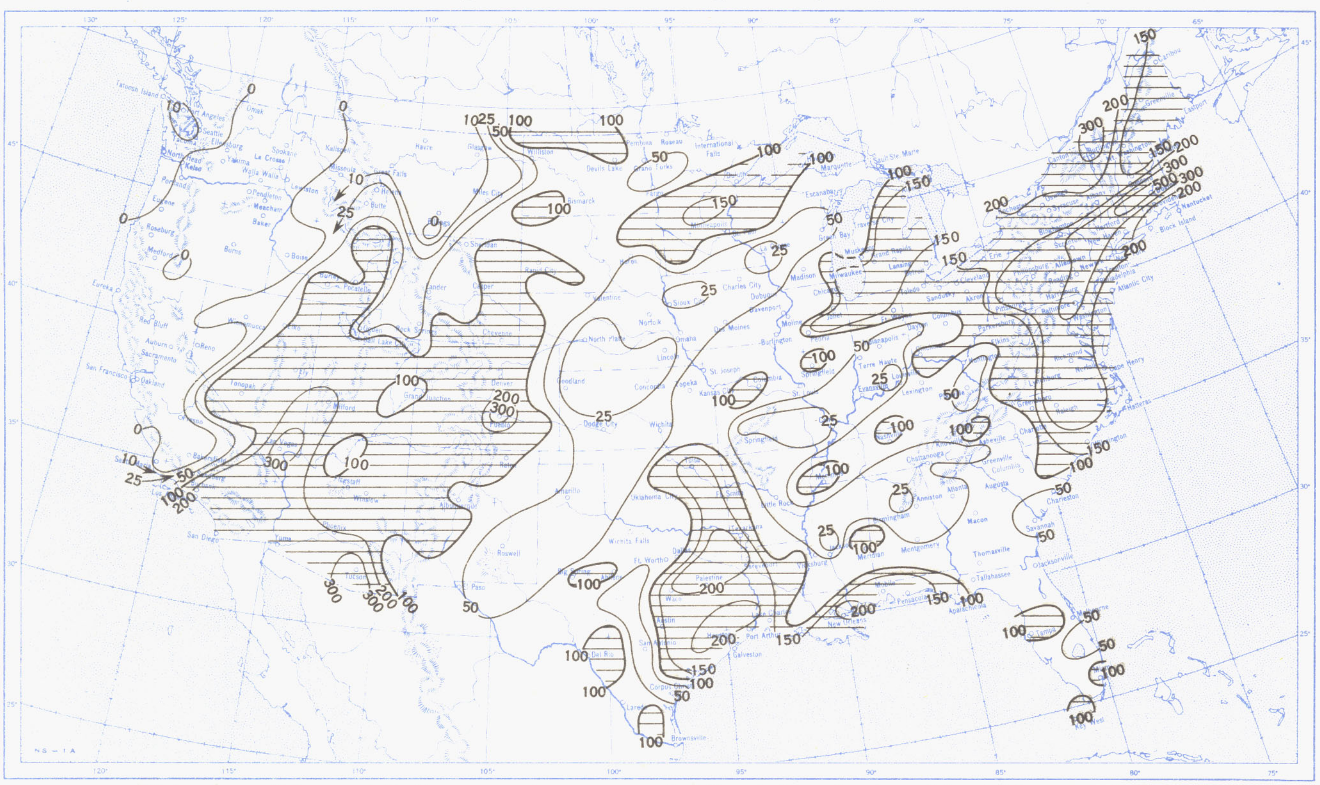
Chart II. Total Precipitation (Inches), August 1955.

Based on daily precipitation records at 800 Weather Bureau and cooperative stations.

Chart III. A. Departure of Precipitation from Normal (Inches), August 1955.



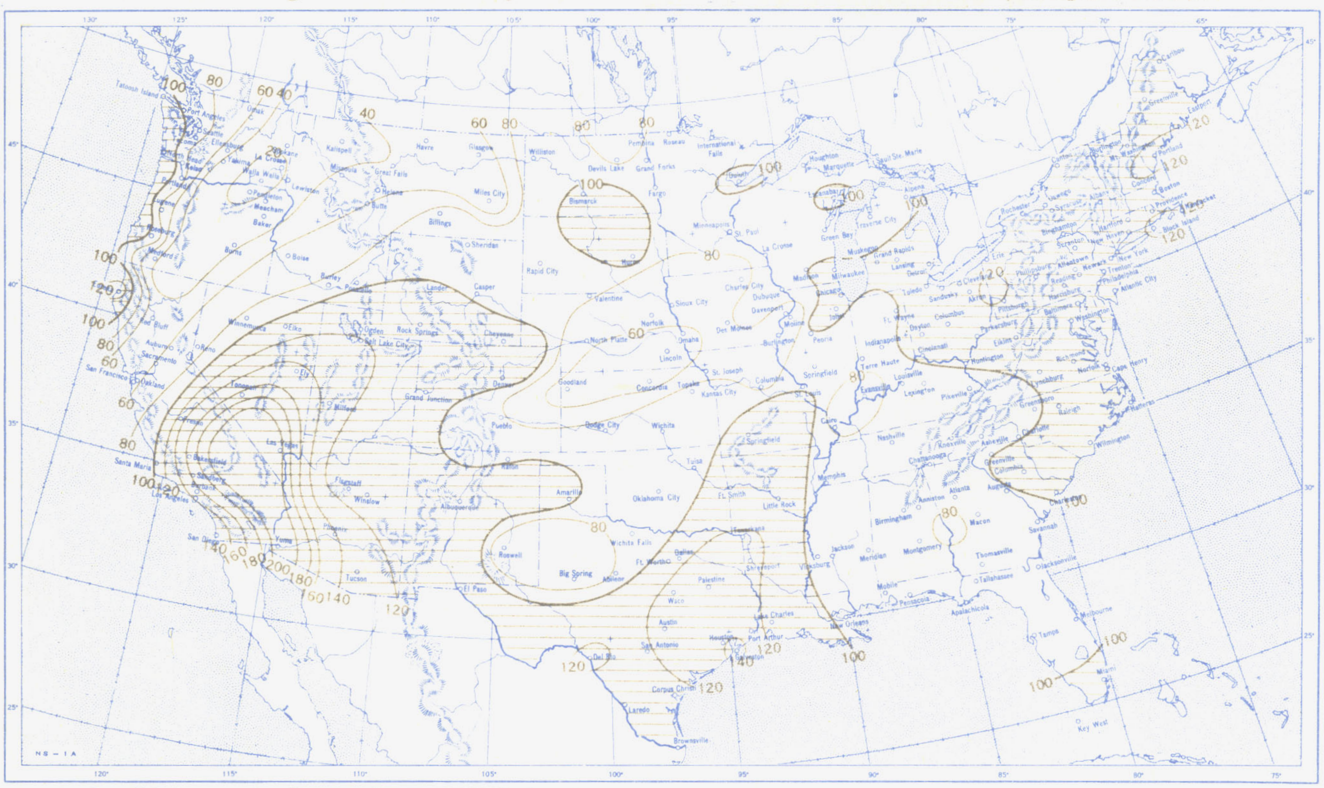
B. Percentage of Normal Precipitation, August 1955.



Normal monthly precipitation amounts are computed for stations having at least 10 years of record.

Chart VI. A. Percentage of Sky Cover Between Sunrise and Sunset, August 1955.

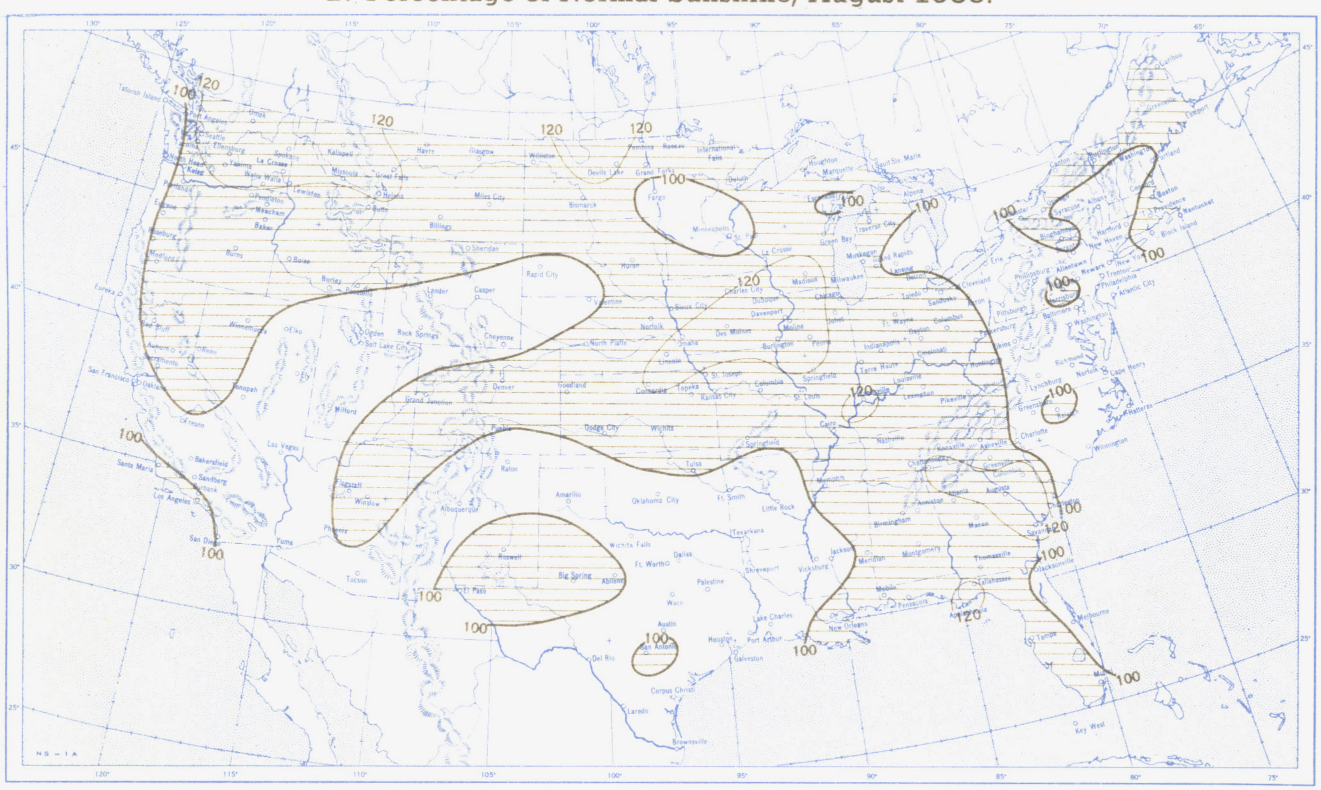
B. Percentage of Normal Sky Cover Between Sunrise and Sunset, August 1955.



A. In addition to cloudiness, sky cover includes obscuration of the sky by fog, smoke, snow, etc. Chart based on visual observations made hourly at Weather Bureau stations and averaged over the month. B. Computations of normal amount of sky cover are made for stations having at least 10 years of record.

Chart VII. A. Percentage of Possible Sunshine, August 1955.

B. Percentage of Normal Sunshine, August 1955.



A. Computed from total number of hours of observed sunshine in relation to total number of possible hours of sunshine during month. B. Normals are computed for stations having at least 10 years of record.

Chart VIII. Average Daily Values of Solar Radiation, Direct + Diffuse, August 1955. Inset: Percentage of Normal Average Daily Solar Radiation.

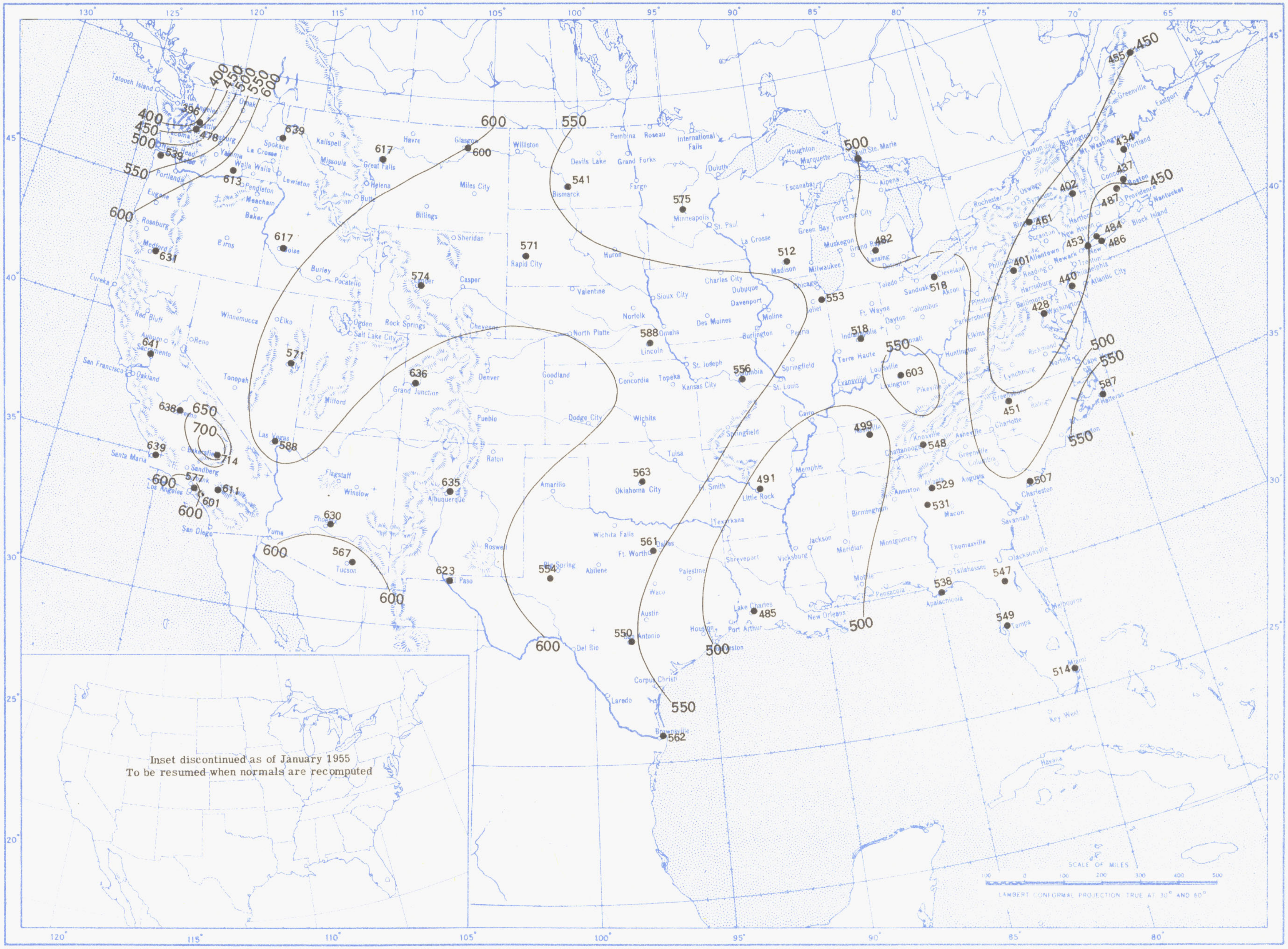
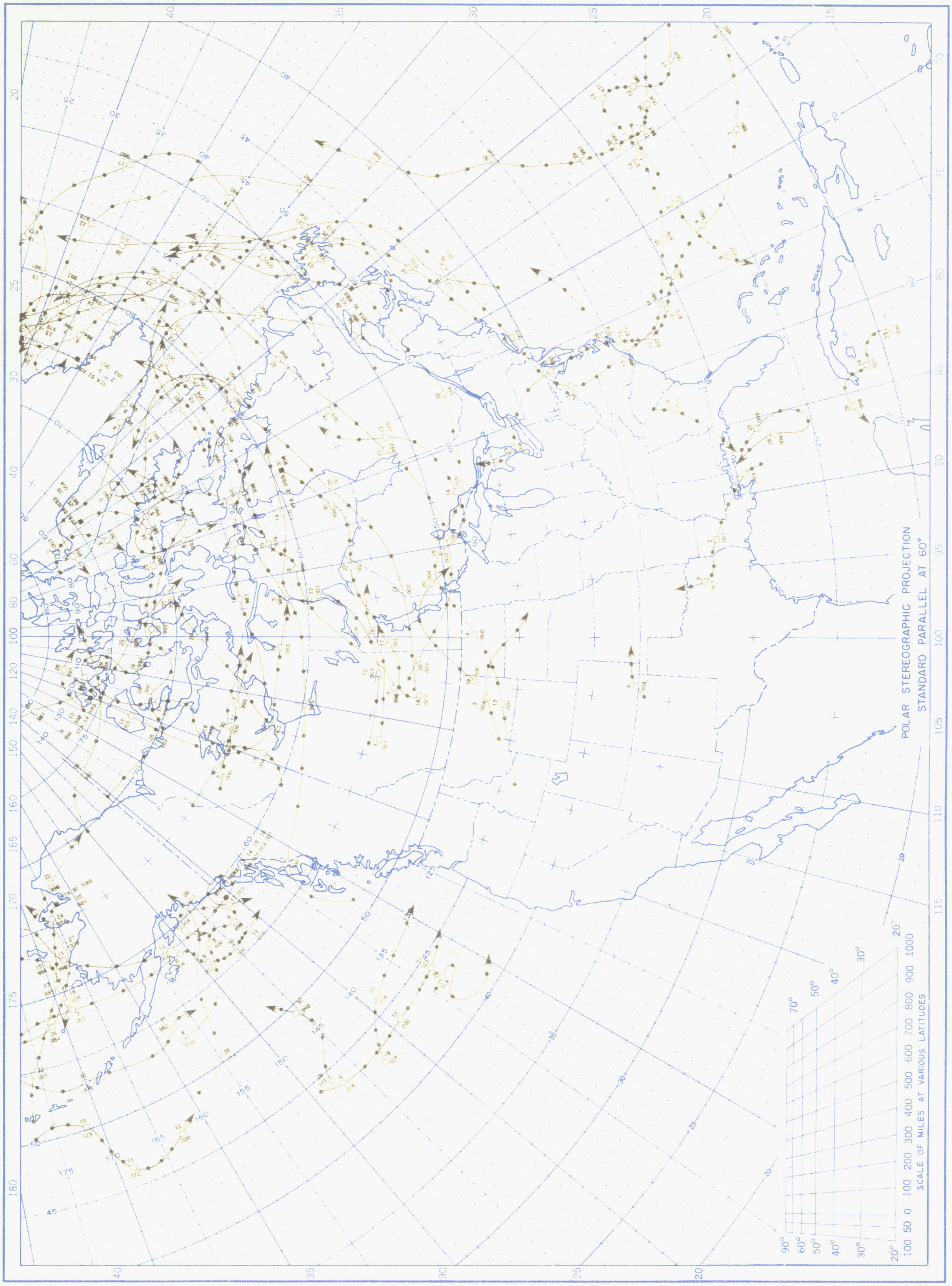


Chart shows mean daily solar radiation, direct + diffuse, received on a horizontal surface in langleys (1 langley = 1 gm. cal. cm. $^{-2}$). Basic data for isolines are shown on chart. Further estimates are obtained from supplementary data for which limits of accuracy are wider than for those data shown.

Chart IX. Tracks of Centers of Anticyclones at Sea Level, August 1955.

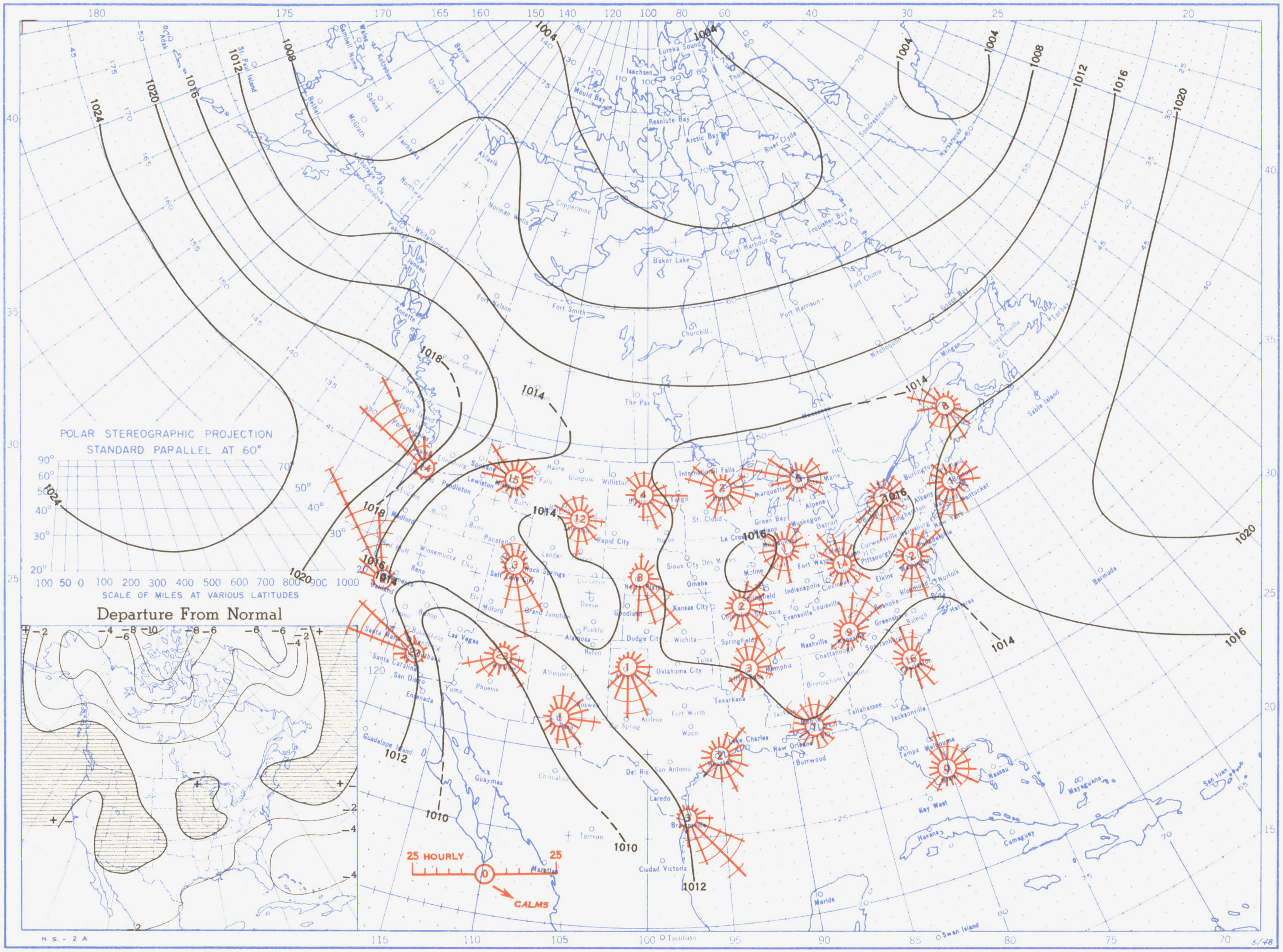
Circle indicates position of center at 7:30 a. m. E. S. T. Figure above circle indicates date, figure below, pressure to nearest millibar. Dots indicate intervening 6-hourly positions. Squares indicate position of stationary center for period shown. Dashed line in track indicates reformation at new position. Only those centers which could be identified for 24 hours or more are included.

Chart X. Tracks of Centers of Cyclones at Sea Level, August 1955.



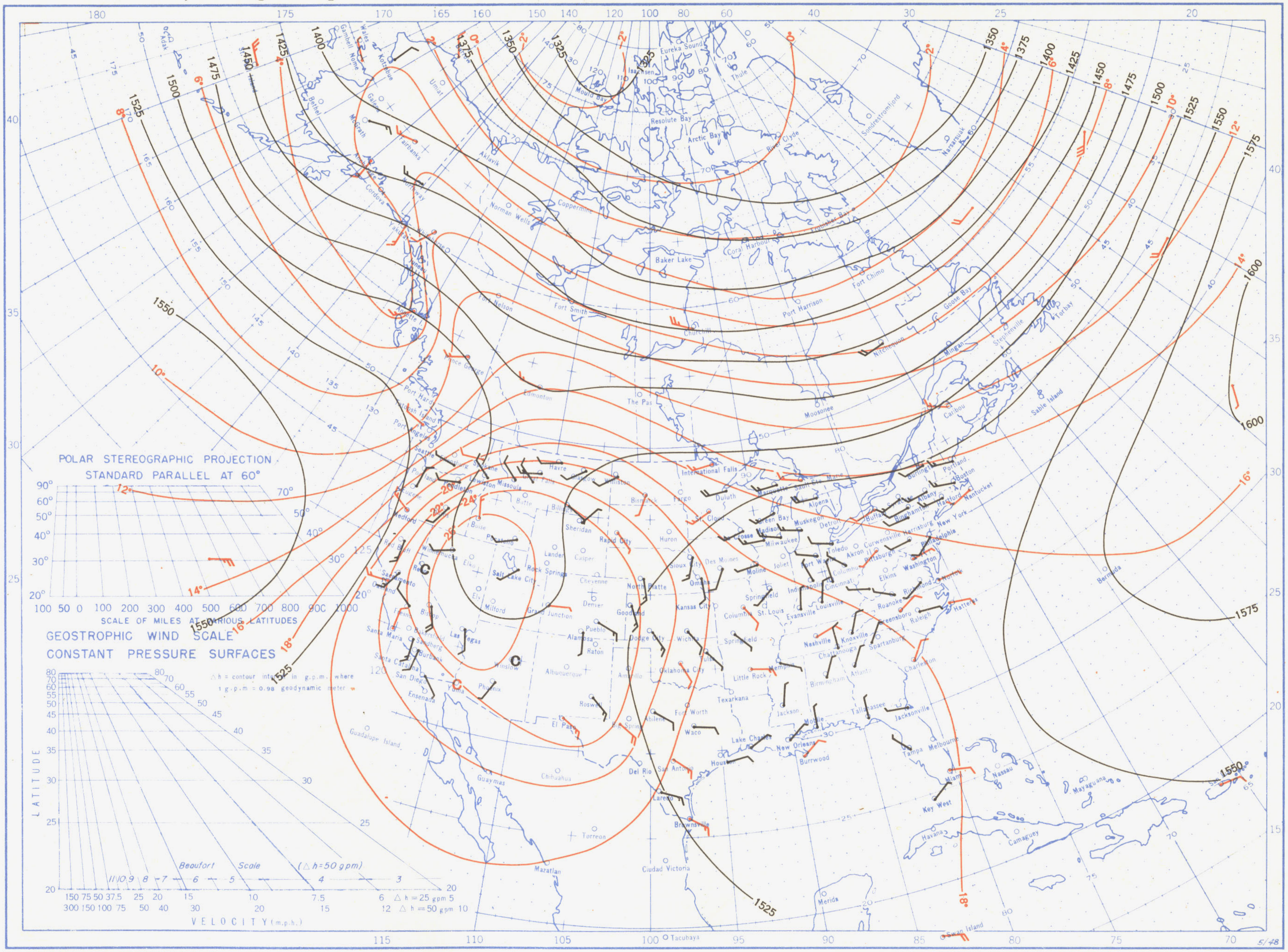
Circle indicates position of center at 7:30 a. m. E. S. T. See Chart IX for explanation of symbols.

Chart XI. Average Sea Level Pressure (mb.) and Surface Windroses, August 1955. Inset: Departure of Average Pressure (mb.) from Normal, August 1955.



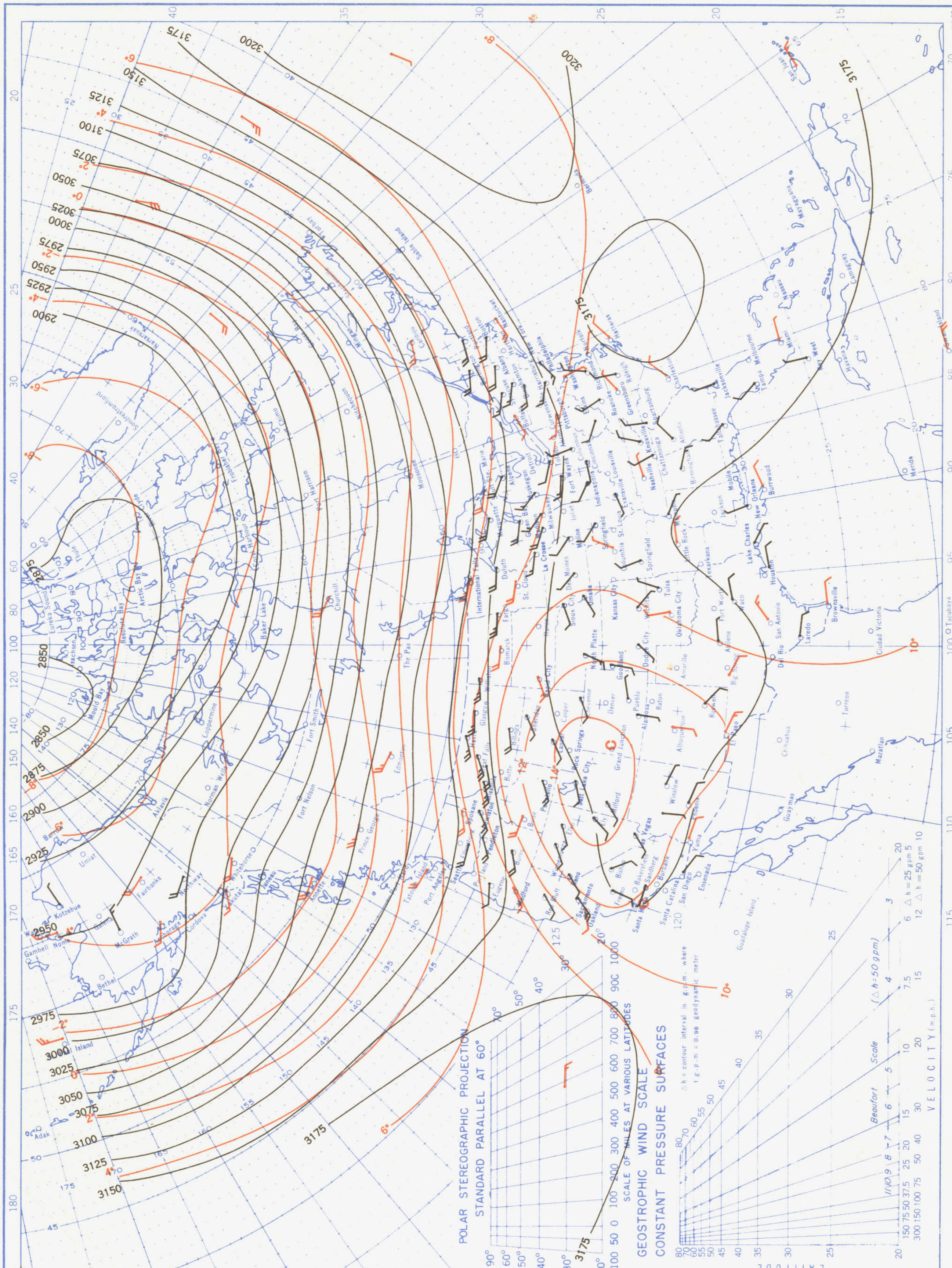
Average sea level pressures are obtained from the averages of the 7:30 a. m. and 7:30 p. m. E. S. T. readings. Windroses show percentage of time wind blew from 16 compass points or was calm during the month. Pressure normals are computed for stations having at least 10 years of record and for 10° intersections in a diamond grid based on readings from the Historical Weather Maps (1899-1939) for the 20 years of most complete data coverage prior to 1940.

Chart XII. Average Dynamic Height in Geopotential Meters (1 g.p.m. = 0.98 dynamic meters) of the 850-mb. Pressure Surface, Average Temperature in °C. at 850 mb., and Resultant Winds at 1500 Meters (m.s.l.), August 1955.



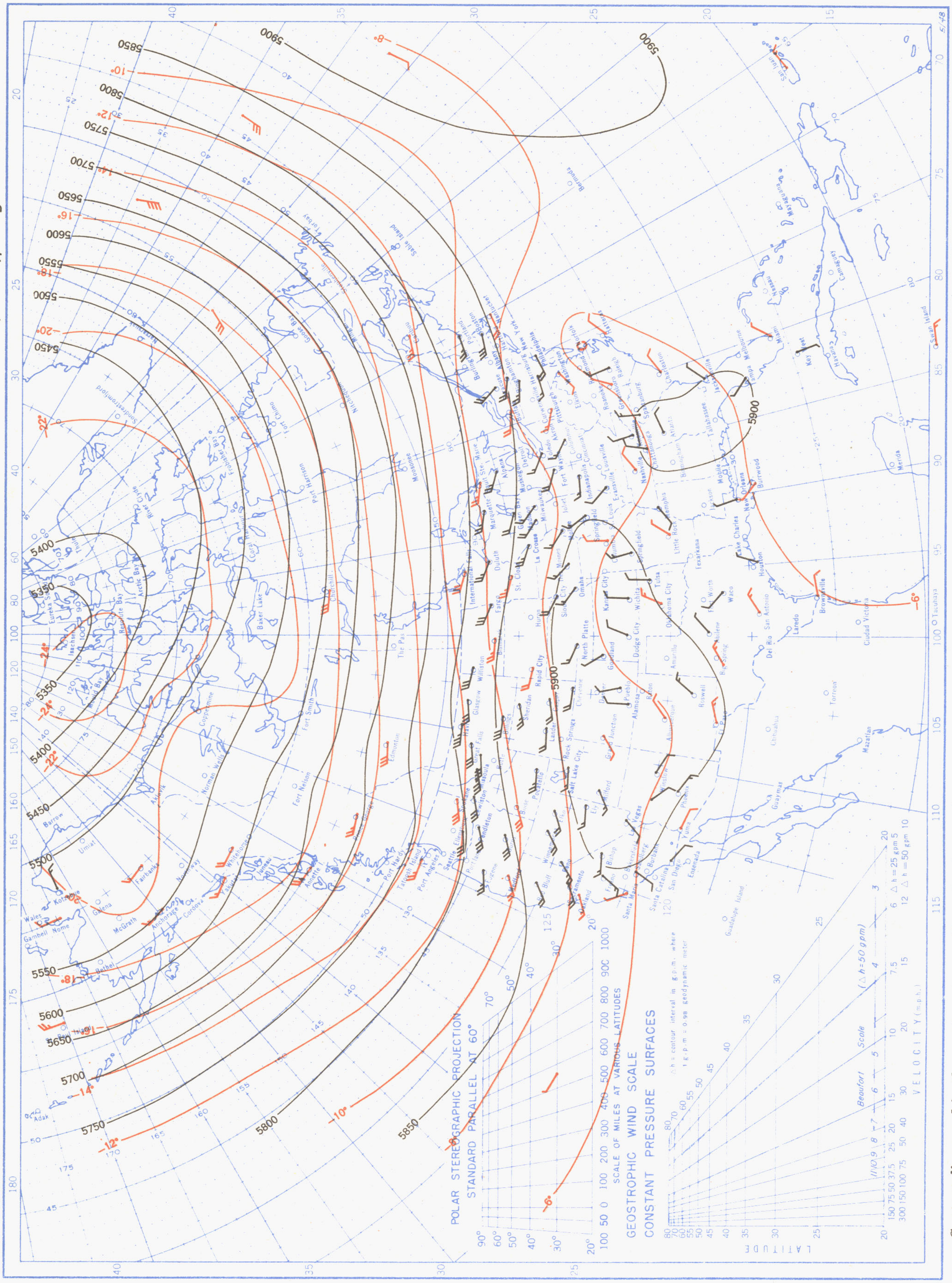
Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins taken at 0300 G. M. T. Wind barbs indicate wind speed on the Beaufort scale.

Chart XIII. Average Dynamic Height in Geopotential Meters (1 g.p.m. = 0.98 dynamic meters) of the 700-mb. Pressure Surface, Average Temperature in °C. at 700 mb., and Resultant Winds at 3000 Meters (m.s.l.), August 1955.



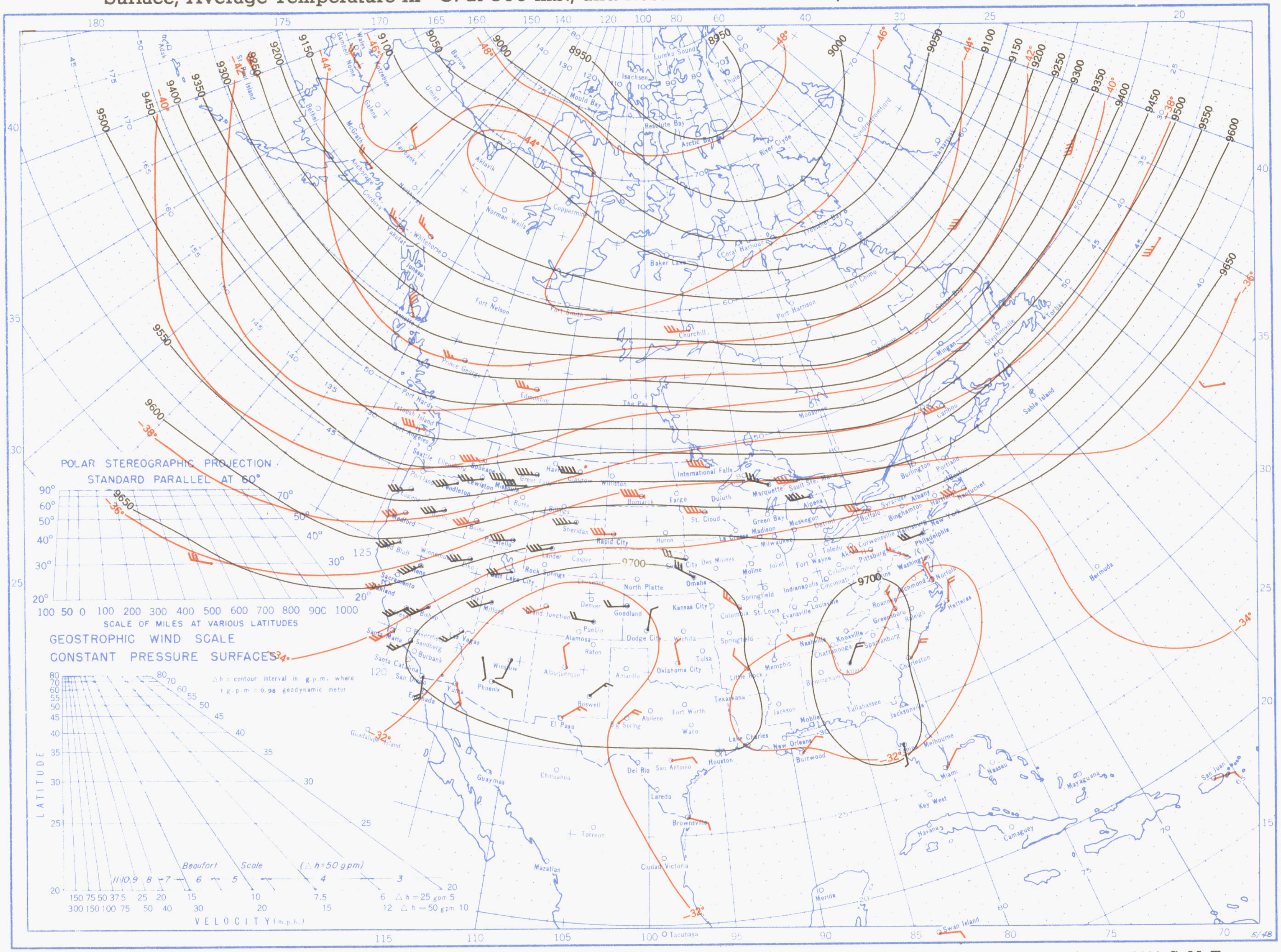
Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins taken at 0300 G. M. T. Wind barbs indicate wind speed on the Beaufort scale.

Chart XIV. Average Dynamic Height in Geopotential Meters (1 g.p.m. = 0.98 dynamic meters) of the 500-mb. Pressure Surface, Average Temperature in °C. at 500 mb., and Resultant Winds at 5000 Meters (m.s.l.), August 1955.



Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins at 0300 G. M. T. Wind barbs indicate wind speed on the Beaufort scale.

Chart XV. Average Dynamic Height in Geopotential Meters (1 g.p.m. = 0.98 dynamic meters) of the 300-mb. Pressure Surface, Average Temperature in °C. at 300 mb., and Resultant Winds at 10,000 Meters (m.s.l.), August 1955.



Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins at 0300 G. M. T. Wind barbs indicate wind speed on the Beaufort scale.